Review of the Genus *Nesodiranchis* Perkins, with Descriptions of Three New Species (Hymenoptera: Cynipoidea: Eucoilidae)[1]

JOHN W. BEARDSLEY[2]

ABSTRACT. The apparently endemic Hawaiian eucoilid genus *Nesodiranchis* Perkins (1910) is reviewed, and a key to the known species is provided. Three new species are described: *N. acanthokylon* from Mt. Kaala, Oahu, *N. bryani* from east Molokai and *N. kauaiensis* from Kauai. Previously described species; *N. ashmeadi* Perkins (type species) from Koolau Mts., Oahu; *N. fuscorubra* Yoshimoto from Kilauea, Hawaii, and *N. nigra* Yoshimoto from Maui, are discussed and figured. *N. aurantiaca* Yoshimoto is transferred to the genus *Weldia* Yoshimoto.

Perkins (1910) proposed *Nesodiranchis* as a subgenus of *Cothonaspis* Hartig, with a single included species, *C. (N.) ashmeadi* Perkins. He emphasized characters of the female antenna ("not clavate, the basal joints of the flagellum larger and longer than the apical, so that the antennae become distinctly attenuate towards the tips"). Also mentioned by Perkins were the large ovate scutellar plate, and the completely open marginal cell of the forewing. Yoshimoto (1962), in his redefinition of the genus, reiterated these characters.

Weld (1952) raised *Nesodiranchis* to full generic status. In addition to the type species he included two neotropical species described by Kieffer: *Cothonaspis signaticornis* and *Miteucoela similis*. I have not seen specimens of these extra-Hawaiian forms, but I believe that probably they are misplaced in *Nesodiranchis*.

Yoshimoto (1962) added three Hawaiian species to *Nesodiranchis*, one of which is misplaced and is here transferred to *Weldia* Yoshimoto.

The present study is based on available *Nesodiranchis* specimens in the collections of Bernice P. Bishop Museum, the University of Hawaii Department of Entomology and the Hawaii State Department of Agriculture, all in Honolulu. Types of all previously described Hawaiian species are in the Bishop Museum and were examined. Types of the new species described here also are deposited in Bishop Museum.

TAXONOMIC RELATIONSHIPS

Nesodiranchis is one of the more distinctive elements of the Hawaiian eucoilid fauna. It belongs to the *Ganaspis* complex of genera defined by Nordlander (1982). This group has speciated extensively in Hawaii, and *Nesodiranchis* appears to be an endemic Hawaiian offshoot of a *Ganaspis*-like ancestor. Characters which this genus shares with *Ganaspis* and related genera include: the form of the metapleuron, which has the hind margin somewhat depressed below the middle and not defined by a complete ridge;

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[2]Department of Entomology, University of Hawaii, 3050 Maile Way, Honolulu, Hawaii 96822.

the presence of a patch of short fine setae on the upper, dorsolateral part of the middle coxa and a band of similar setae on the upper part of the hind margin of the hind coxa (these setae are much shorter and denser than other coxal setae); the petiole of the gaster not sharply expanded in the posterior half; the basal hair ring of the gaster complete dorsally, and third segment (basal flagellomere) of the male antenna slightly curved while the fourth is unmodified.

Two morphological characters have been used to differentiate *Nesodiranchis* species from other endemic Hawaiian species complexes presently placed in *Hypodiranchis* Ashmead, *Pseudodiranchis* Yoshimoto and *Weldia* Yoshimoto. One is the form of the radial cell of the forewing (fig. 1B), which is completely open, with hardly a vestige of marginal closure, and has the distal abscissa of radius about twice as long as the basal abscissa. The distal abscissa is bent slightly outward where it meets the wing margin.

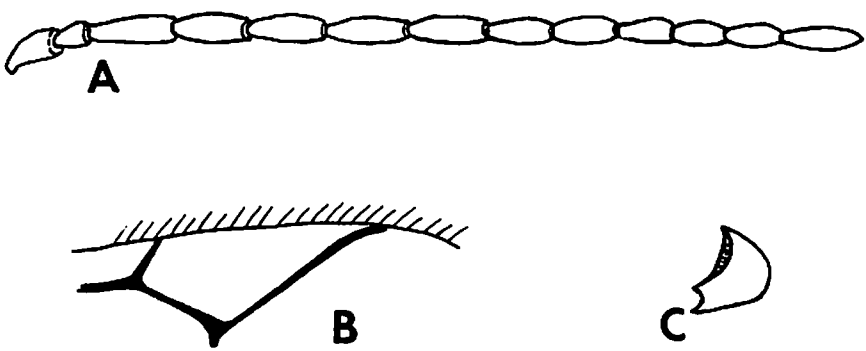

FIGURE 1. *Nesodiranchis ashmeadi* Perkins, female. A, antenna (setae omitted); B, radial cell of forewing; C, left mandible.

The other differentiating character is the form of the female antenna, which is not clavate, having all of the flagellomeres of nearly uniform width (fig. 1A). In the type species, *N. ashmeadi*, the outer flagellar segments are definitely progressively shorter toward the apex, with the penultimate flagellomere about two-thirds as long as the first. In other species this progressive shortening of the outer flagellomeres is less obvious. Some other morphological features which are characteristic of *Nesodiranchis*, but which occur also in some other Hawaiian *Ganaspis* group species, are the relatively broad, smooth pronotal plate; the broad scutellar plate with large subapical pit (fig. 2A); the shape of the head, which is relatively broad and short in dorsal aspect; the presence of fine longitudinal striations or carinulae in the subalar depression and on either side of the mesopleural sulcus (fig. 2B); the strong ridge-like lower margin of the mesopleuron; and the basal hair ring of the gaster which is formed by a sparse band of short, fine, pale setae that is complete dorsally but is not woolly in appearance. These features are remarkably uniform throughout all known Hawaiian species of the genus.

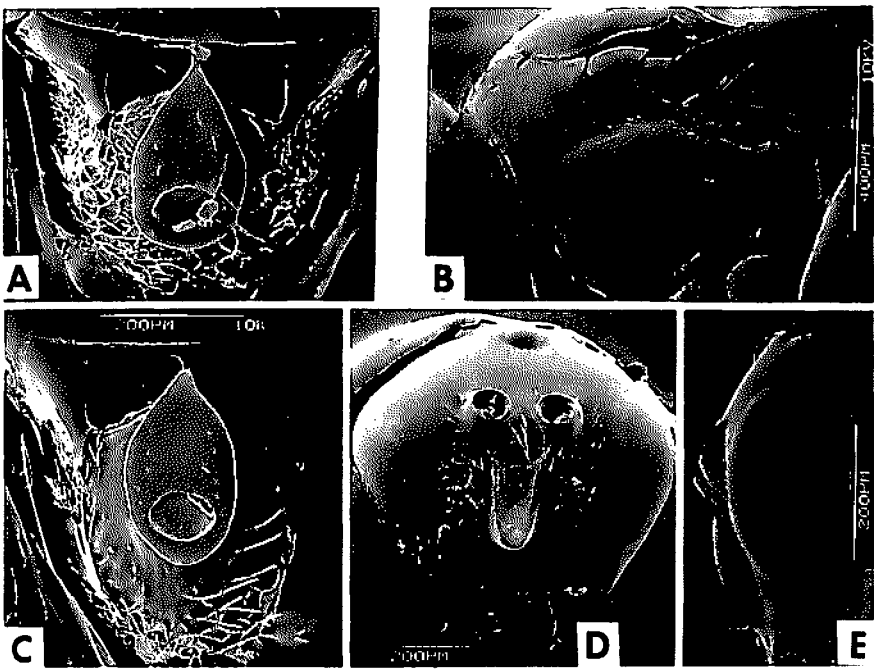

FIGURE 2. A-B, *Nesodiranchis ashmeadi*, male; A, dorsum of scutellum; B, lateral aspect of thorax; C-E, *Nesodiranchis fuscorubra* Yoshimoto, female; C. dorsum of scutellum; D, frontal view of head; E, lateral view of head.

Another feature of *Nesodiranchis*, not emphasized by previous authors, is the presence of specialized structures on the front of the head. Three of the species have the mandibles enlarged and of unusual form, with a conspicuous dorsal tooth or ridge that sometimes is more strongly developed on one mandible than on the other. The remaining species have the mandibles of normal form, but the face bears a strong thorn-like projection. The possible function of these structures is discussed below.

HOST RELATIONSHIPS

Only one species of *Nesodiranchis*, *N. ashmeadi*, has been definitely associated with a dipterous host. This species was reared on at least two occasions by the late Otto H. Swezey from puparia of Diptera in ovisacs of thomiscid spiders. These rearings are recorded on specimen labels, but Swezey did not publish the information. The Diptera, without doubt, were species of the drosophilid genus *Titanochaeta* Knab. So far as is known, flies of this endemic Hawaiian complex develop only as predators in the ovisacs of endemic thomiscid spiders (Hardy 1965). Specimens of *N. ashmeadi* reared by Swezey are labeled "ex agromyzid in spider eggs". However, a puparium with a parasite emergence hole which is mounted with one of

his specimens appears to be that of a drosophilid, and, as no agromyzids or other Diptera except *Titanochaeta* are known to be associated with thomiscid eggs in Hawaii, it is assumed that a species of that genus was the host.

Both endemic thomiscid spiders and *Titanochaeta* species are known from forest environments throughout the Hawaiian Islands. Probably other, if not all, species of *Nesodiranchis* are associated with thomiscid ovisacs as parasites of *Titanochaeta*. Possibly, the morphological specializations of the head (the modified mandibles and frontal spines) seen in species of *Nesodiranchis* may aid the wasps in entering or exiting thomiscid ovisacs. It is of interest that modified mandibles occur in both sexes of the species which possess them, but male specimens of species in which females have a frontal thorn lack this structure.

KEY TO HAWAIIAN NESODIRANCHIS

1. Mandible enlarged, with a conspicuous dorsal protrusion (figs. 3A, B); female face without a distinct mesal projection 2
– Mandible not conspicuously enlarged or bearing dorsal projections; female face with a thorn-like projection (fig. 2D, E, 3C) 4
2. Mandible with dorsal tooth forming thorn-like projection (fig. 1C); Oahu ..... *ashmeadi* Perkins
– Mandible with a strongly developed, continuous dorsal flange-like ridge (fig. 3A, B); Kauai, Molokai 3
3. Gaster pale; height of mandibular flange less than one-half its basal length (fig. 3A); Kauai ..... *kauaiensis*, n. sp.
– Gaster black; height of mandibular flange nearly as great as its basal length (fig. 3B); Molokai ..... *bryani*, n. sp.
4. Gaster pale; female facial projection a simple conical spine (fig. 3C); Oahu ..... *acanthokylon*, n. sp.
– Gaster black; female facial projection formed by a U-shaped ridge (fig. 2D, E); Maui and Hawaii 5
5. Scutellar disc almost completely smooth in both sexes; Maui ..... *nigra* Yoshimoto
– Scutellar disc with more strongly defined ridges, particularly on posterior part (fig. 2C); Hawaii .. *fuscorubra* Yoshimoto

Nesodiranchis ashmeadi Perkins (figs. 1A-C, 2A-B).
Cothonaspis (Nesodiranchis) ashmeadi Perkins 1910:668.
Nesodiranchis ashmeadi, Weld 1952:215; Yoshimoto 1962:804.

Supplemental descriptive notes to references cited are as follows:

Female. Mandible (fig. 1C) enlarged, with a well developed dorsal thorn-like tooth which in one specimen examined is more strongly developed on left mandible than on right. Since the usual number of apical mandibular

teeth in this group is three, and since there are only two such teeth in this species, I assume that the dorsal thorn-like tooth is the displaced and modified homologue of the upper tooth of a normal mandible. Female antenna (fig. 1A) about as long as body; all flagellomeres with numerous very fine rhinaria; basal flagellomere (segment 3) longer than second (segment 4) (6:5); apical flagellomere subequal to first; penultimate shortest, 2/3 as long as apical. Scutellum (fig. 2A) relatively strongly sculptured, with coarse ridging forming rugose reticulate pattern over entire surface; marginal ridge poorly defined due to its blending into overall reticulate pattern. Mesopleuron with faint carinulae in subalar depression, along anterior margin of pleuron and parallel to mesopleural sulcus, more strongly developed anteriorly. Mesopleuron (fig. 2B) a bit more strongly carinulate than in other species, but Yoshimoto's (1962) key statement "entire mesopleuron rugulose" seems incorrect. Basal hair ring of gaster like other species of genus, a dorsally complete band of sparse, short, fine, pale setae. Also, there is a single row of 6-7 longer setae on each side further back on the tergite.

DISTRIBUTION. Oahu. Yoshimoto's (1962) record for Molokai is in error as the specimen represents a distinct species, described as new in this paper.

Nesodiranchis fuscorubra Yoshimoto (figs. 2C-E).

Nesodiranchis fuscorubra Yoshimoto 1962:807.

Supplemental descriptive notes are as follows:

Female. Face dominated by projection formed by long, U-shaped elevated ridge the arms of which originate below each antenna, and gradually increases in height, culminating at the bottom of the U, at about level of lower margin of compound eyes (figs. 2D, E). Female antenna longer than body; second flagellomere (segment 4) slightly longer than first (6:5); flagellomeres 2-5 subequal, outer flagellomeres becoming slightly shorter toward apex; penultimate about 9/10 as long as second; apical segment longest, ratio to second 19:15. Mandible not modified. Mesopleuron with fine carinulae in subalar depression and parallel to mesopleural sulcus. Scutellar disc mostly smooth and shining anteriorly; with low irregular ridging posteriorly and along marginal ridge anteriorly (fig. 2C).

Male. Similar to female except face lacks the conspicuous U-shaped projection, there being only a slight, rounded rise on the face at the position of the spine of the female. Antennae longer than body (6:5) with basal flagellomere (segment 3) slightly curved and a trifle shorter than following segment. Scutellar disc less strongly sculptured than in female.

This species was described from two female specimens from Kilauea, Hawaii. Additional material now at hand includes 5 females and one male from Kilauea, Mauna Loa Strip Road, Saddle Road and Mt. Hualalai, at elevations from 4,000 to 5,300 feet. Several were taken on *Acacia koa*.

Nesodiranchis nigra Yoshimoto.

Nesodiranchis nigra Yoshimoto 1962:808.

This species was known to Yoshimoto only from the holotype female. A male labeled: Puu Kukui, Maui, IV•1959, M. Tamashiro which appears to belong here was found in material housed in Bishop Museum during the present study. Like that of *N. fuscorubra*, the male lacks the facial projection characteristic of the female.

N. nigra is extremely close to *N. fuscorubra*, and may not be specifically distinct. Yoshimoto (1962) separated the two primarily on the basis of stronger ("punctate rugose") sculpture of the scutellar disc in *fuscorubra*. However, although the scutellar sculpture is slightly more strongly developed in the holotype of *fuscorubra* than in that of *nigra*, the difference is not as obvious as Yoshimoto's key suggests. Because of the paucity of the material available for study, it was not possible to critically assess the significance of this character. There do not appear to be any other obvious differences between available specimens of these two forms.

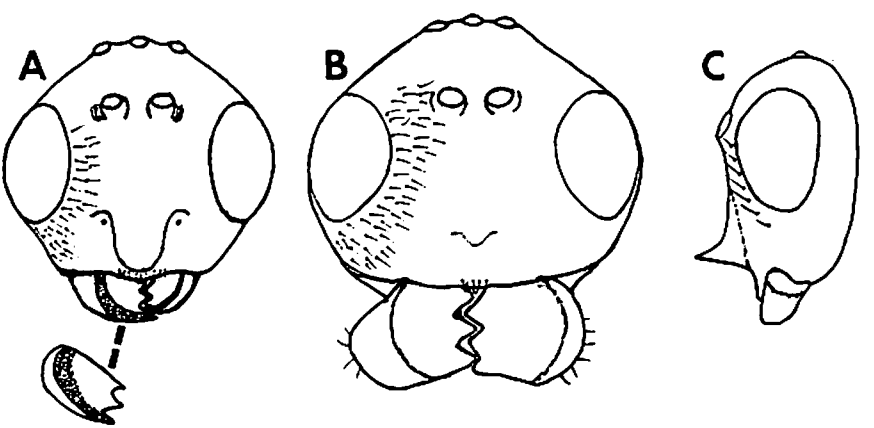

FIGURE 3. Heads of *Nesodiranchis* spp.; A, *N. kauaiensis* n. sp.; B, *N. bryani* n. sp.; C, *N. acanthokylon* n. sp. (lateral view).

Nesodiranchis kauaiensis, new species (figs. 3A, 4A).

Female. Length 2.0mm. Head and mesosoma shining black to dark brown, gaster and legs, including coxae, mostly straw colored; apical segment of front and middle tarsi, entire hind tarsus, apical third of hind tibia and hypopygium, darker. Head moderately broad and short, about as wide as mesosoma across tegulae, dorsally slightly more than twice as wide as mesal length (11:5); width of front between eyes at narrowest about twice width of compound eye; malar distance about half height of compound eye. Face smooth, shining, with paraocular band of sparse silver hair extending below antennal fossa to base of mandible. Mandible black, conspicuously enlarged, with a strong, arcuate dorsal ridge (fig. 3A) (this may be more

strongly developed on one mandible than on the other), highest point near center of ridge, height equal to about one third basal length of ridge or less, ridge runs from base of mandible to tip of lower mandibular tooth. Occipital region smooth, shining, with sparse silvery setae along occipital margin. Antennae 13-segmented, as long as body, rhinaria present on all flagellomeres, but weakly indicated on basal one (segment 3). Second flagellomere longest, slightly longer than first, outer flagellomeres, except apical, subequal, the outer ones slightly shorter than basal; apical flagellomere longer, ratio to preceding 4:3; scape dark reddish brown, remaining segments dark brown to black. Pronotal plate with posterior section moderately broad, smooth, shining, without visible setae, a sparse row of setae on pronotum along upper margin of plate and extending laterally beyond it. Mesoscutum smooth, shining, with sparse marginal row of silvery setae. Scutellum moderately well developed, rounded and slightly protruding behind; disc with a well-defined marginal ridge laterally, somewhat irregular behind, dorsum above marginal ridge largely smooth, with coarse, somewhat irregular semidiagonal wrinkle-like carinulae, these anastomosing in a few places posteriorly, but not reticulate; posterior section below marginal ridge similarly sculptured; dorsum, particularly behind plate, with sparse long silvery setae. Scutellar plate (fig. 4A) extending about two-thirds length of disc; broadly oval in outline, weakly arched front to rear, flat or slightly depressed at center, with a short, steeply declivous anterior neck; subapical pit large, broader than long; 3 or 4 small setigerous pits on each side anteriorly. Mesopleuron mostly smooth, shining, subalar depression with a few weak longitudinal striations, mesopleural sulcus bordered by one or two weak parallel striations anteriorly, and lower mesopleural margin marked by a strong longitudinal ridge. Metapleuron smooth, shining, without conspicuous raised ridges on upper part; with metapleural sulcus originating near middle of anterior margin and curving toward postero-ventral corner; posterior margin weakly depressed below middle, lower portion obscured by setae. Propodeum between carinae with sparse silvery setae; areas laterad of carinae relatively densely setose. Gaster with hypopygium extending beyond posterior margin of large tergite. Basal hair

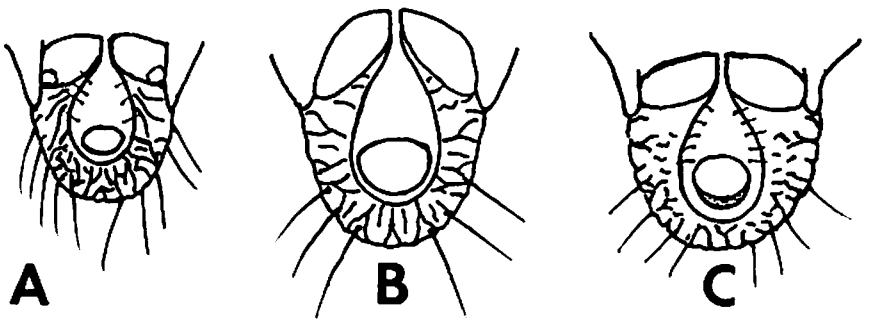

FIGURE 4. Dorsal aspect of scutellum of *Nesodiranchis* spp.; A, *N. kauaiensis* n. sp.; B, *N. bryani* n. sp.; C, *N. acanthokylon* n. sp.

ring composed of sparse band of short, pale setae, complete dorsally. Forewing veins dark brown; radial cell typical for genus.

Male. Similar to female except dorsal ridge of mandible less strongly developed. Antenna 15-segmented, longer than body with strong rhinaria on all flagellomeres; segment 3 (basal flagellomere) about as long as 4, curved and slightly flattened on inner face; outer flagellomeres becoming slightly shorter toward apex, the penultimate about 7/8 as long as basal; apical flagellomere not quite half again as long as penultimate (17:12).

Described from three specimens. Holotype female, allotype male: Kauai, Alakai Swamp Trail, 1200m, 11•V•1989, L. Masner. Female paratype: Kauai, Alakai Swamp Trail, 15•IX•1965, J.W. Beardsley.

The combination of the pale gaster, and the enlarged mandible with conspicuous dorsal ridge, distinguish this species from other known *Nesodiranchis*. It seems closest to *N. bryani*, n. sp. from Molokai, but lacks the extreme development of the mandibular ridge of that species.

The holotype has the mandibular ridge more strongly developed on the right mandible than the left. However, in the paratype female the left mandible is more strongly developed.

Nesodiranchis bryani, new species (figs. 3B, 4B).

Female. Length 2.5mm. Body, including gaster, black to brownish-black; antennae sordid brownish; legs including coxae straw colored; mandibles sordid brownish, apices of teeth darker. Head smooth, shining, moderately broad, slightly but distinctly wider than mesosoma (10:9), width in dorsal aspect slightly less than twice dorsal length (9:5); width of face between eyes at narrowest slightly more than twice width of compound eye (7:3), face with weakly developed smooth rounded hump at level of lower eye margin, malar distance equal to about two thirds height of compound eye. Face with paraocular band of sparse silvery hair extending below antennal fossa to base of mandible. Occipital region smooth, shining, with sparse silvery setae along occipital margin; antenna as long as body, rhinaria present on all but basal flagellomere; basal flagellomere (segment 3) slightly shorter than following one (29:31), outer flagellomeres becoming slightly shorter, so that penultimate (shortest) is 3/4 as long as second (segment 4); apical flagellomere slightly longer than penultimate but shorter than second. Mandibles conspicuously enlarged, each with a large, thin, scoop shaped dorsal extension which protrudes fronto-laterally in front of face when mandibles are closed; apex of mandible with 3 teeth (fig. 3B).

Pronotal plate with posterior section moderately broad, smooth, shining, with a row of fine setigerous punctures just before hind margin. Mesoscutum smooth, shining. Scutellum moderately well developed, rounded and slightly protruding behind; disc with marginal ridge well developed, dorsal part (above ridge) coarsely rugose, sculpture dominated by irregular ridges extending from beneath margin of scutellar plate to marginal ridge; these sometimes curved or branching, sometimes anastomosing, particularly behind, with some wrinkling between major ridges;

disc below marginal ridge strongly, coarsely, reticulately ridged. Scutellar plate (fig. 4B) paddle-shaped, moderately elongate-oval, arched front to rear, with sharply declivous anterior neck, subapical pit very large, its length equal to about 1/3 overall length of plate. Mesopleuron smooth, a few weak longitudinal striations in subalar depression; mesopleural sulcus strongly developed, with faint parallel striation immediately above; lower margin marked by strong ridge. Metapleuron and propodeum as in other species of genus.

Gaster of normal form, basal hair ring complete dorsally, apparently pale, several setae wide as in other *Nesodiranchis* spp., but individual setae largely obscured by glue. Forewing, including radial cell, as in other species of genus.

Male. Unknown.

Described from a single specimen. Holotype female: Molokai, Kainalu, 1500 ft., 27•VII•1927, E.H. Bryan, Jr., on *Metrosideros*. Yoshimoto (1962), under *N. ashmeadi*, listed as Molokai records for that species two specimens with collection data the same as cited above, one prefaced by the statement "not in series". I found one specimen with these data in Bishop Museum, described above as holotype of *N. bryani*, and believe an error was made in listing these data twice in Yoshimoto's paper.

This species is named for the collector, the late Mr. Edwin H. Bryan, Jr., a long-time staff member of the Bernice P. Bishop Museum.

N. bryani appears to be most closely related to *N. kauaiensis*, also described in this paper. The latter also has a flange-like dorsal protrusion from the mandible, but it is less strongly developed.

***Nesodiranchis acanthokylon*, new species (figs. 3C, 4C).**

Female. Length 2.0mm. Head and mesosoma dark brown to blackish. Scape of antenna, mandible except teeth, and legs except as noted below, straw colored. Mandibular teeth, apical segment of front and middle tarsi and entire hind tarsus sordid brownish; gaster pale reddish brown. Head mostly smooth, shining, with a patch of fine longitudinal carinulae below each eye mesad of site of malar sulcus, which is obsolete; about as wide as mesosoma, in dorsal aspect slightly more than twice as wide as long (12:5); width of face between eyes at narrowest about equal to that of compound eye; malar distance slightly more than half height of compound eye (6:11); with a broad, sparse band of silvery setae extending below antennal torulus to base of mandible; a dense row of fine setae on anterior margin of clypeus; center of face without setae, with a mesal carina arising above middle and terminating in a strong, thorn-like projection situated slightly below level of lower margin of compound eye (fig. 3C), face slightly depressed either side of thorn ridge. Mandible well developed, but not exceptionally large, lacking strong dorsal cusps or ridges, apex tridentate.

Pronotal plate with posterior portion smooth, shining moderately broad. Mesoscutum smooth, shining, with setae in a sparse marginal row and sparsely scattered on disc. Scutellum moderately well-developed,

rounded, hardly protruding behind; marginal ridge well-defined laterally, anastomosing with other ridges posteriorly; disc dorsally (above marginal ridge) smooth, shining anteriorly, with weak transverse ridging arising from marginal ridge; posteriorly with anastomosing series of smooth ridges producing a coarsely reticulate pattern; disc below marginal ridge with a few smooth ridges extending downward; disc with sparse, long, fine, silvery setae. Scutellar plate extending about ¾ length of disc, broadly tear-shaped in dorsal outline; with short, sharply declivous anterior neck; surface smooth, shining, nearly flat slightly arched from front to rear, with a large, nearly circular subapical pit and several small setigerous pits anteriorly (fig. 4C). Mesopleuron smooth, shining, with a few longitudinal striations in subalar depression; mesopleural sulcus well-defined; lower margin marked by strong carina. Metapleuron smooth, shining, without conspicuous dorsal ridges. Propodeum with dorsum between carinae smooth, shining, with sparse fine setae; with dense setae laterad of carinae. Forewing, including radial cell, as in other species of genus.

Gaster with basal hair ring complete dorsally, composed of moderately sparse, pale, short, fine setae in a band of 4-5 setae wide, not woolly in appearance.

Male. Unknown.

Described from a single specimen. Holotype female: Oahu, Mt. Kaala, 1200-1500 ft., X•29•44, E.C. Zimmerman, beating shrubbery.

This species appears to be related to *N. nigra* Yoshimoto from Maui and *N. fuscorubra* Yoshimoto from Hawaii. It differs in the form of the frontal projection and in having the gaster pale.

Weldia aurantiaca (Yoshimoto), **new combination.**

Nesodiranchis aurantiaca Yoshimoto 1962:805.

On examining the male holotype of this species, I found that the radial cell of the forewing is completely closed by a strong vein along its anterior margin. On the basis of the wing venation, the relative lengths of the first and second flagellomeres (1 shorter than 2), the relatively short broad head, and the broad flat scutellar plate, I assign this species to the genus *Weldia* Yoshimoto. It is very close to, and possibly conspecific with *Weldia flavida* Yoshimoto.

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